ISSN 0704-3716

Canadian Translation of Fisheries and Aquatic Sciences

No. 5464

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Original title: Sovremennoe sostoyanie i perspektivy lososevogo rybovodstva v basseine Amura

Source: Presented at the Meeting of Soviet and Canadian Scientists on Joint Research in the North Pacific, Khabarovsk, U.S.S.R., 1988, 5 p.

Original language: Russian

Available from:
Canada Institute for Scientific and Technical Information
National Research Council
Ottawa, Ontario, Canada K1A 0S2

1989

6 typescript pages

Secretary of State | Secrétariat d'État

90-00604/

MULTILINGUAL SERVICES DIVISION – DIVISION DES SERVICES MULTILINGUES

TRANSLATION BUREAU | BUREAU DES TRADUCTIONS

Client's No.–N° du client	Department – Ministère	Division/Branch – Division/Direction	City – Ville
0554	DFO	Scientific Publications	Ottawa
Bureau No.–N° du bureau	**Language – Langue**	**Translator (Initials) – Traducteur (Initiales)**	
3511501-06	Russian	B.P.	JUN 19 1989

SOVREMENNOE SOSTOYANIE I PERSPEKTIVY LOSOSEVOGO RYBOVODSTVA V BASSEINE AMURA

THE PRESENT STATE AND THE PROSPECTS OF SALMON CULTURE IN THE AMUR RIVER BASIN

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Artificial reproduction of diadromous Pacific salmon is carried on in the Amur River basin by four fish-rearing stations - the Teplovskii, Bidzhanskii, Gurskii, and Udinskii whose total capacity is about 100 million downstream-migrants of autumn chum.

A special feature of the Amur salmon-rearing stations is their remoteness from the Amur estuary. Thus, the Teplovskii station is located at 1300 km, the Bidzhanskii 1500km, the Gurskii 700 km, and the Gudinskii 200 km from the estuary. This characteristic has a considerable impact on the survival of both the downstream-migrants and the spawners.

In the late 70's and early 80's, the run of spawners to two largest stations was mediocre and unable to provide the projected volume of eggs for incubation. As a result, the release of juvenile fish dropped to 45-60% of the overall projected capacity. In recent years, in connection with the lowering of catch quotas for autum chum to almost the 50% level and a stricter regulation of the industry, the number of spawners returning to the stations has increased to thirty-forty thousand specimens. Starting with 1983, the Teplovskii salmon-rearing station having a projected capacity of 44.5 million incubates 30-62 million, the Bidzhanskii with a projected capacity of 20 million incubates 28-34 million eggs.

The reproductive efficiency at the Amur stations is quite low. For

the past 20 years, the average annual return at the Teplovskii salmon-rearing station amounted to 0.05% (0.004-0.14%), at the Bidzhanskii to 0.09% (0.005-0.41%), at the Gudinskii to 0.05%. At the Gurskii station the return was not recorded, since spawners for reproduction purposes here come mostly from natural spawning grounds. The total return to the estuary is estimated in the average at 1.96%, about half the projected numbers are taken by the fishing industry, the share of station-reared fishes in the total catch amounting to 2.9-16.8%. /2

The economic efficiency of salmon-rearing stations is evaluated on the basis of the intermediate result - the number and the average weight of juvenile fish released from the station into the basal rivers.

The low return of fishes reared at the stations is caused by higher elimination at the various stages of ontogenesis.

During the period of embryogenesis, a somewhat larger waste of eggs occurs at the stations which use water from open sources (Teplovskii, Gurskii and, partly, Bidzhanskii). That water contains much suspended matter, its temperature fluctuates considerably (for instance, at the Teplovskii station from 2.4 to 4.7°C, at the Bidzhanskii from 3.5 to 7.4°C.). At the Teplovskii station the situation is complicated by the unsatisfactory respiratory exchange: the oxygen content of water drops during incubation to 2.0 mg/l, and during the keeping period to 2.7 mg/l, which is much lower than the optimum.

The eggs in the hatching frames are arranged in 1.5-2 layers, they are in close contact with each other, therefore the control of saprolegniosis requires a repeated manual sorting and washing. In the process the spatial orientation of eggs is often changed, the animal pole ends up at the bottom, which has a negative effect on the condition of the developing embryos. The presence of these negative factors produces on the whole weakened juvenile fish.

The keeping of yolk-sac larvae at the leveled bottom of incubating apparatus leads to the migration of the fat drop to the caudal part of the yolk sac, which causes disruptions in the morphology of internal organs: an incorrect and premature opening of the air bladder and necrosis of the mucous membrane of the intestines. /3

The feeding of juvenile fish that have started to swim is carried out in foraging basins by using feeds of local origin. The recipes and composition of local feeds vary depending on the amount and nomenclature of the raw material available at any given moment (stuffing made with bodies of spawners, fish flour, yeast, spleen, dried water fleas). In recent years, partial use of RGM-type feeds and walleye pollock eggs has become popular. The expenditure of feed for one million juvenile fish, depending on the duration of feeding, is 5.3 to 619 kg. However, there is no increase in the mass of juvenile fish in relation to the amount of feed used, which is explained by the different quality of feeds and a considerable waste of feed at the platforms.

In final count, about half the juvenile fish of two largest salmon-rearing stations are released without reaching the standard weight of 0.5 gr.

According to data for 1988, up to 40% of young fish perish in the Teploe Lake (Teplovskii salmon-rearing station) during the growing period. In the sector of the basal Bira River extending 270 km from the hatchery to the estuary the rate of survival in May is 21.6% and in June 1.3% (the fluctuation of water temperature in the growing basin in June is up to 10°C and more). Thus, from the 33.6 million fingerlings released by the station to forage 3.8 million, or 11.3%, were counted in the lower course of the basal river. The reasons for such a high rate of elimination were the low quality of juvenile fish, low viability, excessive duration of the downstream migration, destruction by predatory fish and fish-eating birds.

It is estimated that about 50% of hatchery-reared juvenile fish perish immediately in the Amur River after passing through the estuary of the basal river.

A correlation analysis of some factors influencing the numbers of the spawning-grounds part of the station's subpopulations produced the following results. In the Birskii subpopulation, the average weight of the released juvenile fish essentially correlates with the number of spawners in the year of return of the dominant age group ($r = 0.71$), /4

the optimal weight being within the limits of 0.5-0.55 mg. The relation of the number of released juvenile fish and the number of spawners is average (η = 0.55). In the Bidzhanskii population, the relation between these indexes is tenuous (η = 0.37 and 0.17 respectively), which is explained by the considerable amount of natural reproduction in the basin of this river. An evaluation of the impact of poaching on the numbers of spawning stocks by means of an analysis of the water level in the basal rivers during September-October in relation to the number of spawners counted at the stations produced an opposite result: in the Bidzhan River this relation is stronger (η = 0.65) than in the Bira River (η = 0.22). Apparently, this depends on the quality of the protection program for spawning stocks: the channel of the Bira is protected throughout the entire sector from the estuary to the station, that of the Bidzhan only with a 15-20 km radius from the station.

In order to increase the efficiency of the Amur salmon-rearing stations, the following measures are necessary:

1. The evaluation of the performance and the employees' salaries must be made dependent on the final result - the commercial return to the fishery and the return of spawners to the stations; this requires a reliable system of estimating the share of hatchery-reared fish in the commercial catches by means of wholesale tagging of the released juvenile fish.

2. The quality of water supply to the incubation basins must meet the standard requirements, meaning that the Teplovskii and Gurskii salmon-rearing stations must switch to sheltered water supply.

3. To duplicate the natural conditions of egg incubation, a hatchery frame must be designed in which the hatching ova would occupy an isolated and strictly fixed position.

4. To control saprolegniosis, it is necessary to promote the administration of "violet K" and "brilliant green" drugs in dialytic packages, so that small doses of antiseptic preparation could have a continuous effect on the eggs. These drugs reduce the incidence of saprolegniosis almost by half. /5

5. To assure a normal morphophysiological development of yolk-sac

larvae and prevent the juvenile fish from starting to swim prematurely, the yolk-sac larvae must be kept in an artificial substrate from crimped fibre plastic. This increases the percentage of normally developed larvae from 3-5 to 99-100%.

6. The feeding of juvenile fish must take place in growth basins separate for each age group in accordance with the date of hatching. Special balanced feeds must be used according to a set technology and schedule of feeding.

7. The release of juvenile fish from the stations should take into account the duration of downstream migration from natural spawning grounds.

8. To prevent losses during the migration period along the basal river, the young fish should be transported from the growth basins in oxygen bags or containers by automobile or helicopter and kept two or three days for adaptation at the estuary of the basal river.

9. It is necessary to develop reliable viability criteria for juvenile fish by taking into account the regional characteristics of the basin.

10. It is necessary to develop a method of forecasting the size of the spawning-grounds part of the station's subpopulations by monitor- their structure and numbers.